consideration. To ensure that all GSO FSS and BSS cases were covered, NGSO FSS proponents agreed to supplement the validation limits with: (1) operational limits and additional operational limits, to protect more interference-sensitive links; (2) limits to protect very large earth stations; and (3) limits to protect DBS receivers located at high latitudes (such as Alaska) where propagation may not be as favorable. MVDDS proponents have not been held to the same high standard, with the result that DBS operators will be far better protected from co-primary NGSO FSS systems than they will be from secondary MVDDS systems.

c. The Commission's proposals are inconsistent with its treatment of NGSO FSS vis-a-vis GSO BSS in the 17.3-17.7 GHz band.

In the very same Report & Order in which it made the MVDDS allocation, the Commission concluded that NGSO FSS gateways should not be permitted in the 17.3-17.7 GHz bands because of the threat of harm to a future DBS consumers. The Commission stated that "sharing of the 17.3-17.7 GHz band by ubiquitous BSS downlinks and NGSO FSS uplinks would be difficult" and that "[t]he resulting limitation on the location of BSS receive earth stations would be overly restrictive on ubiquitous BSS receivers."[32/]

The Commission reached this conclusion even though: (1) the NGSO FSS gateway uplinks that would be deployed in the band are quite limited in number (30-40 in the U.S. in the case of SkyBridge, for example); (2) NGSO FSS proponents proposed

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32/ R&O, ¶ 158.

shielding the NGSO FSS gateways to shrink interference zones to a few hundred meters around each gateway site; and (3) DBS operations will not even be deployed in the band until at least 2007, if ever. In contrast, MVDDS transmitters would be numerous (placed every 10 miles in the case of Northpoint, leading to potentially tens of thousands of transmitters in the U.S.), and ubiquitous NGSO FSS user terminals point in all directions, including toward MVDDS transmitters. Moreover, the Commission has not proposed that MVDDS operators be required to shield their transmitters, or take any other steps other than limiting power under some scenarios, to protect NGSO FSS terminals located in the vicinity. Finally, NGSO FSS systems are already planned, and are seeking to deploy and commence service as soon as possible.

Therefore, under the Commission's proposed rules, operations of MVDDS facilities in the band will pose a vastly greater constraint on deployment of NGSO FSS consumer equipment than that which would be posed by NGSO FSS gateways on DBS consumer equipment in the 17.3-17.7 GHz band. Thus, the Commission's decision to permit entry of MVDDS in the 12.2-12.7 GHz band in the absence of strict rules designed to protect the consumer NGSO FSS service, while refusing to permit entry of NGSO FSS gateways in the 17.3-17.7 GHz band, is completely arbitrary.

III. THE SKYBRIDGE PROPOSAL FOR NGSO FSS/MVDDS SHARING ADDRESSES THE PROTECTION REQUIREMENTS OF BOTH SERVICES, WHILE AVOIDING UNNECESSARY OR DEBILITATING BURDENS ON EITHER SERVICE.

The previous section demonstrates that the Commission's proposals are based on false assumptions, are fraught with glaring factual and regulatory inconsistencies, and, at bottom, are flatly unworkable if the Commission truly desires the development of NGSO FSS systems. In short, there is no rational basis for adopting these proposals. On the other hand, the SkyBridge Proposal would meet all of the relevant parties' legitimate concerns.

The Commission stated in the Further Notice that "we believe that Northpoint's and SkyBridge's proposals generally set forth a viable sharing scheme."[33/] However, the Commission did not propose to follow *a single point* of the SkyBridge proposal. The Commission did not even acknowledge, let alone discuss, the most critical aspects of SkyBridge's proposal.[34/]

For example, the Commission never mentioned the importance of limiting MVDDS emissions into NGSO FSS user terminals to prevent receiver saturation. Similarly, the Commission did not discuss SkyBridge's proposal to impose additional PFD limits on

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33/ FNPRM, ¶ 279.

34/ There is nothing in the record to support the Commission's treatment of the SkyBridge Proposal. Northpoint's only response to the SkyBridge Proposal was a 2-page letter that made the entirely unsupported claim that the power limits proposed by SkyBridge "would not permit the effective functioning of Northpoint's system and therefore are completely unacceptable to Northpoint." Letter from David H. Pawlick, Counsel to Northpoint Technology Ltd., to Magalie Roman Salas, July 11, 2000. This response, filed one day after the SkyBridge Proposal, does not even identify, let alone demonstrate, any constraint on the Northpoint system caused by the SkyBridge Proposal.

NGSO FSS satellite emissions that would apply only into operational MVDDS receivers, in lieu of tightening the internationally-adopted PFD limits, as Northpoint has urged and the Commission has now proposed. Even worse, the Commission claims that "SkyBridge states that it can accept Northpoint's proposal [on tightening of the PFD limits], but only if the power of MVDDS signals is also limited."[35/] As discussed below, no reading of the SkyBridge Proposal can lead to such a conclusion.

Put simply, the implication in the Further Notice that the Commission has even considered the SkyBridge proposal is incomprehensible.[36/] The Commission cannot adopt rules based on such a cursory review of what is a entirely constructive proposal made by a party that stands to be very severely affected by the Commission's determinations in this proceeding. Below, SkyBridge again explains the concerns addressed in the SkyBridge Proposal, and urges the Commission to carefully review their merits.

A. The SkyBridge Proposal Takes Into Account The Requirements Of Both MVDDS And NGSO FSS Systems, And Equitably Spreads The Sharing Burdens Between Them.

During the course of this proceeding, Northpoint has made many assertions and promises regarding the operation of its proposed MVDDS system, in an effort to assure NGSO FSS proponents that the interference into NGSO FSS systems will be tolerable. However, MVDDS proponents have been unwilling to commit to such statements in any way, repeatedly arguing that any parameters used in the sharing studies must correspond to

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35/ FNPRM, ¶ 278.

36/ FNPRM, ¶ ¶ 279-280.

"typical" operations, and that MVDDS systems must have flexibility to deviate from such operation.[37] It must be abundantly clear to the Commission why such statements have given little comfort to NGSO FSS operators.

SkyBridge has long maintained that *if* MVDDS operators were willing to commit to certain assertions and promises, a feasible sharing arrangement could be developed. Just as NGSO FSS operators have been required to back up their technical showings of non-interference with a firm commitment to respect important limits for the protection of co-primary services, MVDDS proponents must also be required to accept certain limits on their operations, consistent with their assurances and technical showings. As explained below, it is possible to craft such limits so as to minimize the burdens imposed on MVDDS. The proposals made by SkyBridge stem from exhaustive study of the Northpoint filings, and numerous meetings with Northpoint representatives, and correspond closely to the promises and assertions made by Northpoint during this proceeding.

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[37] As demonstrated above, this situation is in total contrast to the approach of NGSO FSS operators, which have been obliged by the Commission to make firm commitments, with no exceptions, to GSO FSS and GSO BSS operators regarding the power levels emitted by the NGSO FSS systems, the limits for which have been developed based on "worst-case" studies. The use of "typical" values, rather than worst-case values, is not appropriate for most aspects of sharing studies, because the results fails to bound within acceptable levels the interference generated by one of the parties, to the detriment of the other.

1. The Commission Must Implement Rules Specifically Designed To Ensure That NGSO FSS Operators Can Provide Uninterrupted Service To All User Terminals.

a. Rules designed for the protection of DBS systems will not serve to protect NGSO FSS systems.

As discussed above, MVDDS systems have been designed to protect DBS receivers, but not to protect NGSO FSS user terminals operating in their vicinity. The Commission claims in the Further Notice that, by protecting DBS services, MVDDS systems will inherently provide some protection to NGSO FSS.[38/] The Commission's reasoning fails to show any understanding of the operation of NGSO FSS systems.

The GSO arc, to which all DBS receivers point, is seen towards the south in the United States. Both MVDDS and NGSO FSS systems must therefore avoid emissions that would interfere with receivers pointing toward this arc. MVDDS proponents propose to point their transmitters generally toward the south, so that their emissions enter the sidelobes and backlobes of the DBS receivers. However, because NGSO FSS user terminals do not communicate with NGSO FSS satellites seen near the GSO arc, user terminals tend to communicate with satellites seen north of the United States, in the direction of the MVDDS transmitters. In other words, *when both MVDDS and NGSO FSS systems point away from DBS receivers, they tend to point at each other*, which gives rise to the potential for

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[38/] FNPRM, ¶ 225.

interference. For this reason, rules designed for the protection of DBS systems will not serve to protect NGSO FSS systems.[39/]

b. The protection of NGSO FSS systems should be assessed from the point of view of the NGSO FSS receiver.

In order to assess the impact of MVDDS operations on an NGSO FSS system, it is crucial to determine the envelope of the interference that may be received by the NGSO FSS user terminals from MVDDS transmitters. This envelope depends on several MVDDS transmitter characteristics, including, inter alia: (1) the power transmitted; (2) the antenna gain; (3) the height of the transmitter; (4) the tilt of the antenna; (5) the polarization of the transmitter; (6) the density of the transmitters; (7) the terrain profile; and (8) transmitter latitude.

With respect to Northpoint, all of these parameters have been provided as ranges of values, which makes it difficult to properly assess the actual interference that

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39/ Additionally, if MVDDS emissions were bounded by a maximum number of minutes of DBS link unavailability, as the Commission has proposed, the permitted MVDDS power levels that will be seen by NGSO FSS receivers would depend on DBS link quality. Such a result was rejected in the NGSO FSS/DBS context because, inter alia, it was considered essential that: (1) compliance with the limits be proven at all points on earth; (2) existing and future DBS systems be protected no matter what their characteristics; and (3) the expected interference envelope be fixed to permit DBS system operators to design future systems. To cover the United States, MVDDS operators will be deploying tens of thousands of transmitters, and with the Commission's proposal, there would be no way for NGSO FSS operators to anticipate the interference levels that could be generated. Just as DBS operators required from NGSO FSS operators, NGSO FSS operators need to be able to check compliance of MVDDS systems with the limits, to know that future changes in NGSO FSS system operation will be protected, and to know the expected interference from MVDDS systems into any of its NGSO FSS receivers.

would be generated.[40] Northpoint has refused to examine the worst-case interference that could be caused by its ranges of parameters, insisting that analysis should be conducting using "typical" parameters.[41] It has therefore been very difficult to conduct a rigorous technical sharing analysis, because a change in each of the above-mentioned parameters can have a dramatic impact on the interference generated in NGSO FSS receivers.

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[40] For example, despite the fact that Northpoint has urged that all sharing analysis be based on its "typical" transmitter EIRP of 12.5 dBm, the Broadwave Applications specified a maximum transmitter EIRP of 45 dBm (in each application see Exhibit 2 at 2). Since then, transmitter EIRP has been stated as being between 8.5 dBm and 22.5 dBm. See, e.g., Northpoint NPRM Comments, Technical Annex, at 2. And even this range has recently been revised to be between 7 dBm and 27 dBm. See First Northpoint Response to MITRE Questions, at 2. (Note that the 27 dBm figure is still 2.5 dBm above that which Northpoint proposes for the unusual case of Mt. Wilson, which Northpoint claims is likely to have to largest service area radius in the U.S. due to the height of the transmitter and the large uninhabited parkland surrounding the Mt. Wilson site.) The antenna gain has never been properly described in three dimensions, and the Commission proposes not to apply any specific rules on MVDDS transmit antenna patterns. FNPRM, ¶ 315. The declared range of antenna HAAT has varied from 30 to 4500 meters in the Northpoint NPRM Comments, Technical Annex, at 2, and from 100 to 5000 feet in the First Northpoint Response to MITRE Questions, at 2. Northpoint has also claimed that the service area "could be as small as 1 km pocket . . . [while] the largest would likely be no more than 30 miles. . . " First Northpoint Response to MITRE Questions at 2.

[41] Typical parameters often used by Northpoint are transmitters located every 16 km (about 10 miles), with an EIRP of 12.5 dBm and a height of 150 m. See, e.g., Northpoint NPRM Comments, Technical Annex, at 2. As seen in the previous footnote, this represents a situation far from the worst-case in terms of the interference levels that could be generated into NGSO FSS receivers, taking into account various combinations of the parameters provided, and their ranges of values. As the Commission is well aware, this is the opposite of what was required of NGSO FSS applicants, which have been required to present all interference analysis for the worst possible configurations, regardless of the actual likelihood of such configurations.

Clearly, terrestrial systems need a degree of flexibility in their deployment parameters, as they are constrained by the terrain profile, transmitter installation restrictions, and the like. To permit this flexibility, and to take into account the number of variables that could affect any interference analysis, it is necessary to adopt sharing rules that achieve an overall environment in which NGSO FSS user terminals can operate, without overly constraining the particular configuration of the MVDDS system.

Bounding the interference environment in this way cannot be accomplished by merely limiting the maximum power transmitted by each MVDDS transmitter, because the interference received by the NGSO FSS user terminals depends not only on the antenna power, but also the antenna pattern, height, tilt, etc. A logical way to overcome this difficulty is to define the protection requirements not from the point of view of the MVDDS transmitter, but from the point of view of the NGSO FSS receiver, by, for example, limiting the power received at the NGSO FSS receiver. In addition to limiting a parameter that is actually relevant to NGSO FSS protection, this approach has the advantage that it can be used to bound the aggregate interference an NGSO FSS system may receive from several MVDDS transmitters of a single network within the field of view of the NGSO FSS user terminal. This is, of course, exactly what has been done successfully in the case of the NGSO FSS/DBS sharing arrangement, and the SkyBridge proposal is based on this important concept.

The approach also has advantages for MVDDS operators. Instead of imposing a hard limit on any particular MVDDS parameter (such as transmitter power), it provides MVDDS operators full flexibility on how to meet the limits at the NGSO FSS

receiver. As the Commission recognized, each transmitter siting will have its own particular characteristics, and this approach allows the MVDDS operator to take these difference into account, thereby optimizing operations, while still protecting NGSO FSS systems.[42/]

c. Even in cases where NGSO FSS systems have the capability to implement frequency diversity to avoid interference from MVDDS systems, strict limits are still necessary on MVDDS emissions in order for NGSO FSS systems to successfully employ this capability.

In assessing the interference environment for NGSO user terminals, the service area of each MVDDS transmitter can be divided into two zones:

- The "Green Zone," in which the power received on the ground is low enough to permit co-frequency operation of the MVDDS system and the NGSO FSS system; and
- The "Red Zone," in which the interference from the MVDDS transmitter is too high to permit co-frequency operation of the NGSO FSS system.[43/]

MVDDS applicants have not proposed any interference mitigation technique that they could implement in their systems to permit operation of NGSO FSS user terminals in the Red Zone.[44/] Rather, Northpoint has argued that NGSO FSS operators themselves

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[42/] For example, transmitter power in excess of 12.5 dBm may sometimes enable an MVDDS operator to enlarge its service area without adversely affecting co-frequency satellite operations, when, for example, the transmitter is pointed across a large body of water. FNPRM, ¶ 311.

[43/] The size and the location of the Red Zone depends on the transmission characteristics of the MVDDS transmitter. Based on the technical parameters available for the Northpoint MVDDS system, the Red Zone will start at or near the foot of the transmitter tower, depending on the antenna pattern used.

[44/] R&O, ¶ 220. As noted by the Commission, Northpoint states that it can protect only those NGSO FSS systems that employ a highly-elliptical orbit ("HEO"); other NGSO FSS systems would require system modifications

(continued...)

should take steps to prevent interference to NGSO FSS user terminals in the Red Zone, in particular, by using a mitigation technique it calls "Alternate Beam Assignment."[45/] The Alternate Beam Assignment technique is more generally known as "frequency diversity." This technique assumes that each affected NGSO FSS user terminal has the ability to limit its communications to a different band, in this case the 11.7-12.2 GHz band adjacent to the band shared by NGSO FSS and MVDDS systems.[46/] However, even for systems with this ability, this technique imposes significant constraints on the NGSO FSS operator.[47/] It can affect the load of carriers and can impede the multiplexing capabilities of the system, and

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[44/] (...continued)
and/or employment of interference modification techniques. However, HEO systems represent only two out of the eight NGSO FSS systems proposed in the U.S. Moreover, the various interference mitigation techniques cited by Northpoint for other systems (terrestrial arc avoidance, satellite diversity, increased receiver antenna gain and alternative beam assignments), R&O, ¶ 220, are not compatible with current NGSO FSS system designs, and the necessary modifications would be extremely burdensome to implement. See supra note 18. There is no justification for requiring only one co-primary system to take such steps for the protection of another. As discussed below, a satisfactory sharing arrangement will require that reasonable burdens be placed on both services, not just one.

[45/] See, e.g., Northpoint NPRM Comments, Technical Annex, at 34.

[46/] As discussed in Section III.B.1.d(i) below, not all of the proposed NGSO FSS systems appear to have this capability.

[47/] As noted in a U.S. contribution to ITU-R Working Party 4-9S, "constraining NGSO FSS systems to employ DCA [Dynamic Channel Assignment i.e., frequency diversity] would result in significant increases in the complexity and cost of the user terminals, satellites and network management functions. It would also result in significant losses of system traffic capacity and preclude the ability of NGSO FSS systems to provide low-cost, fiber-like quality of service for broadband applications worldwide." ITU-R Document 4-9S/147, April 1999, U.S.A.

thus the capacity of the system, if used to handle the traffic of a large number of user terminals.[48/]

Putting aside the obvious inequities of such a proposal, which puts all of the sharing burden on NGSO FSS systems, ***if frequency diversity is to be used at all, certain limitations on MVDDS power are still required,*** a point completely ignored in the Further Notice. Specifically, even if the NGSO FSS user terminals located in the vicinity of a Northpoint transmitter are technically capable of utilizing at any time a carrier outside the 12.2-12.7 GHz band, the following is required:

- ***The power transmitted by the MVDDS system*** in the receiving band of the NGSO user terminal (11.7-12.7 GHz for the SkyBridge user terminals) ***must not saturate the RF layer of the NGSO FSS user terminal.***[49/] That is, even if a user terminal is planning to employ a carrier outside of the 12.2-12.7 GHz band, this carrier can be

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[48/] SkyBridge has fully explained the reasons for this in several filings in this proceeding. See supra note 18. None are even acknowledged by the Commission in the Further Notice. In addition, as SkyBridge has pointed out on previous occasions, a requirement for frequency diversity to avoid MVDDS interference severely constrains the ability of SkyBridge to deploy its "relay links," which allow it to quickly commence service nationwide. See Written *Ex Parte* of SkyBridge L.L.C., ET Docket No. 98-206, February 18, 2000 at 34.

[49/] It must be understood that, even though the user terminals employing frequency diversity will operate in a band adjacent to those used by the MVDDS transmitters, the situation is quite different from that traditionally encountered with adjacent band operations. In this case, NGSO FSS is allocated in, and will in general use, the entire 11.7-12.7 GHz band, and the NGSO FSS receivers will therefore receive emissions across that band. The RF front end of the user terminal is wideband, covering this 1 GHz frequency range in which carriers can be received. Even when carriers in the lower 11.7-12.2 GHz band are employed by the NGSO FSS system, MVDDS interference in the upper 12.2-12.7 GHz band still represents interference into the receiving band of the user terminal. The situation cannot be compared to the case of a truly adjacent-band service interfering via out-of-band emissions.

rendered unusable due to saturation of the radio layer by sufficiently high emissions in the 12.2-12.7 GHz band.

- ***The interference generated by the out-of-band emissions of the MVDDS transmitter must be low enough*** to allow unconstrained operation of carriers available outside the band 12.2-12.7 GHz.

- ***The number of NGSO FSS user terminals affected by the constraint of operating in a different band*** (i.e, the number located in the Red Zone) ***must be limited***. The greater the number of affected user terminals, the greater the constraints on system operation. At some point, NGSO FSS user terminals are effectively excluded from the band. It is therefore critical to limit the number of NGSO user terminals for which the choice of the carrier is constrained by MVDDS interference.

In the SkyBridge Proposal, SkyBridge explained the kinds of limits that must be placed on MVDDS operations to meet these requirements, and hence to ensure that frequency diversity is a viable option for user terminals located in the Red Zone.[50/] In Section III.B below, SkyBridge again summarizes these proposals, as augmented to address certain proposals and clarifications contained in the Further Notice.

2. The Commission's Rules For The Protection Of MVDDS Receivers Must Avoid Unnecessary Burdens On NGSO FSS Systems.

In addition to providing adequate protection for NGSO FSS receivers, it is also necessary to assess the protection requirements of MVDDS receivers with regard to NGSO FSS satellite emissions. As explained above, Article S21 of the ITU Radio

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[50/] This assumes that the lower band frequencies will be available to all NGSO FSS systems, and that all systems can implement frequency diversity as proposed by Northpoint. Neither assumption is necessarily true. The Commission has not yet decided how the various NGSO FSS systems will share spectrum, and, as discussed in Section III.B.1.d(i) below, not all of the systems appear to be capable of using frequency diversity in this way.

Regulations already imposes requirements on satellites in the band for the protection of terrestrial FS services.

However, Northpoint proposes to operate with user terminals smaller than the standard antennas used by the FS in the 12 GHz bands, and with much smaller margins and very different performance objectives.[51/] As a consequence, Northpoint seeks an additional 10 dB of protection at low elevation angles, as compared to the Article S21 limits. However, a restriction at low elevation angles directly affects the level of power that can be transmitted at higher elevation angles, because the levels generated at low elevations correspond to the side-lobes of emissions at higher elevation angles. A reduction in side-lobe power therefore requires a corresponding reduction in the power of the main beam. Such a systematic tightening of the Article S21 limits by 10 dB in all satellite pointing directions would severely constrain, and probably prevent, the NGSO FSS from serving regions with satellites seen at low elevation angles. Therefore, the Commission's proposal would threaten the viability of LEO systems, by reducing coverage of the satellites, which would in turn result in either a reduction of capacity over certain areas or an inability to maintain continuous coverage.

51/ As noted above, these differences have been a point of heated controversy within the ITU-R study groups, and have never been accepted by the participants, because they deviate significantly from those employed by FS systems and no adequate justification for the various discrepancies has ever been provided by Northpoint. These differences have also hampered efforts to conduct rigorous sharing analysis, comparable to that used to develop the rules for protection of FS systems or DBS systems from NGSO FSS emissions.

The Commission states that NGSO FSS systems have the ability "to protect MVDDS receivers with spatial and frequency diversity,"[52] and notes that such techniques are already used to protect GSO FSS systems.[53] The Commission's comparison is very misleading, however. While an NGSO FSS system may have some flexibility to implement some spatial or frequency diversity, these techniques do not provide an infinite resource which can be tapped to solve sharing situations not contemplated at the time of system design.[54]

In order to share with GSO FSS systems, many, if not all, of the proposed NGSO FSS systems have some capability to implement spatial diversity. SkyBridge, for example, was designed to provide continuous service while honoring a non-operating zone that extends $\pm 10°$ on either side of the GSO arc.[55] This is extremely constraining to NGSO FSS systems, LEO systems in particular, but is a burden NGSO proponents have accepted to enter a band already used by GSO systems. If spatial diversity is also used to protect MVDDS receivers, NGSO FSS systems would have to suffer a similar non-operating zone at low elevation angles, over an azimuth range of about 180°.[56] This would increase

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[52] FNPRM, ¶ 279.

[53] FNPRM, ¶ 279, n.566.

[54] See supra note 18.

[55] None of the user terminals in a SkyBridge gateway cell will communicate with a satellite that is in the "non-operating zone" of any of the user terminals in the cell. Traffic to the cell is always handled by NGSO satellites located out of this zone.

[56] This is because the NGSO FSS system would have to protect potential

(continued...)

substantially the set of prohibited configurations for NGSO FSS communications, constraining system operation well beyond that contemplated at the design stage.

Moreover, despite the Commission's statement to the contrary, frequency diversity is not employed by NGSO FSS systems to protect GSO FSS systems, in view of the EPFD limits adopted to protect GSO receivers. Protecting MVDDS via frequency diversity would require NGSO FSS satellites to avoid using the 12.2-12.7 GHz band at low elevations, which would once again jeopardize the coverage and continuous service capabilities of NGSO FSS systems.

Notwithstanding the fact that no rigorous analysis has ever been provided supporting the need to tighten the PFD limits for the protection of Northpoint, SkyBridge has accepted certain of Northpoint's claims. In the SkyBridge Proposal, SkyBridge introduced a regulatory solution to this problem, that would protect MVDDS receivers where they actually exist and actually require additional protection, but would not constrain NGSO FSS operation where there is no such need. The Commission completely ignored this proposal in the Further Notice.

56/ (...continued)
MVDDS user terminals pointing in a wide range of azimuths, corresponding to the numerous MVDDS transmitters located in the footprint of an NGSO FSS satellite beam (up to 1000 Northpoint transmitters may be located in the footprint of a SkyBridge beam, for example).

B. The SkyBridge Proposal Can Be Implemented Via Relatively Simple Rules And Procedures.

In contrast to the unworkable and discriminatory proposals contained in the Further Notice, the regulatory framework discussed below would provide a basis for feasible, albeit mutually constraining, coexistence between NGSO FSS and MVDDS systems in the 12.2-12.7 GHz band.

1. Limits Applied To MVDDS Operations

As explained above, in order to even permit use of frequency diversity by NGSO FSS systems, certain constraints on MVDDS operations are required. In sum, the following principles must be embodied in the Commission's regulations:

- It must be ensured that over most of the MVDDS service area, the interference levels generated into NGSO FSS receivers across the 12.2-12.7 GHz band are low.
- In the areas in which this is not possible, it is still necessary to ensure that the NGSO FSS user terminal radio layer will not be saturated.
- Finally, it must be ensured that interference received in the adjacent 11.7-12.2 GHz band from MVDDS systems operating in the 12.2-12.7 GHz band is sufficiently low so that NGSO FSS carriers in the 11.7-12.2 GHz band may operate unconstrained by MVDDS interference.

a. Limit on size of "Red Zone"

As discussed above, use of frequency diversity is not without significant cost to NGSO FSS systems; it can affect the load of carriers and can impede the multiplexing capabilities of the system, and thus the capacity of the system, if used to handle the traffic of a large number of user terminals. It is therefore critical to limit the number of NGSO FSS user terminals for which the choice of carrier is constrained by MVDDS interference. To accomplish this goal, it is necessary to define a limit on the power received by most

NGSO FSS user terminals from an MVDDS system over a large proportion of the MVDDS service area.[57]

SkyBridge proposes to limit this interference to -106.5 dB(W/m^2) in an NGSO FSS carrier of 22.6 MHz bandwidth -- which corresponds to a PFD of -120 dB(W/m^2/MHz) -- over 90% of the MVDDS transmitter's service area.[58] This level would define the "Red Zone," which would cover no more than 10% of the MVDDS transmitter's service area.

From the NGSO perspective, such a limit would avoid use of frequency diversity by too many user terminals, permitting the operator to maintain reasonable efficiency in the traffic multiplexing capabilities of the system. Moreover, Northpoint has stated that the size of the largest "Red Zone" for any proposed NGSO FSS system in the Ku-band will be less than 10% of a Northpoint transmitter's service area.[59] Therefore, the proposed limit should not constrain MVDDS systems like Northpoint's.

As specified in the attached Exhibit, SkyBridge therefore proposes that a PFD limit of -120 dB(W/MHz) be incorporated in the Commission's rules, applicable over 90% of the service area of each MVDDS transmitter. Compliance with this PFD limit can be assessed via computation prior to the deployment or modification of each MVDDS transmitter, with the licensee filing with the Commission the results and all background data

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[57] The service area of an MVDDS transmitter is the area within which its user terminals can receive service. In the case of Northpoint, the service area appears to be the area within which the received signal strength is higher than approximately -156 dBW over a 24 MHz carrier. Northpoint NPRM Comments, Technical Annex, at 2.

[58] SkyBridge Proposal at 5.

[59] Northpoint NPRM Comments, Technical Annex, at 32.

necessary for the computations. This data would provide the boundaries of each "Red Zone," which NGSO FSS operators could then use to determine the user terminals that are likely to require use of frequency diversity.[60/]

b. Limit on in-band emissions to avoid saturation

It is also necessary to limit the interference levels received by NGSO FSS user terminals located within the Red Zone, to ensure that frequency diversity can be used by those terminals to maintain continuous service to the consumer. As discussed above, this requires both that the MVDDS emissions within the 12.2-12.7 GHz band not saturate the NGSO FSS receiver, and also that the MVDDS out-of-band emissions in the 11.7-12.2 GHz band not interfere with the NGSO FSS communications.

In order to protect NGSO FSS user terminals from saturation due to MVDDS emissions, it is necessary to limit the aggregate power emitted from MVDDS systems. Northpoint has explained that in each geographic area, only one MVDDS system would use the entire 12.2-12.7 GHz band,[61/] and, therefore, SkyBridge assumed in its analysis that only one MVDDS system would generate high levels of interference over a given area. The EPFD that is necessary to protect SkyBridge receivers from saturation due to the aggregate interference from a MVDDS system (the emissions of all MVDDS transmitters within the 12.2-12.7 GHz band) is -132.1 dB(W/m^2/4 kHz). This corresponds to an interference level of -68 dBm at the output of an operational NGSO earth station antenna having a gain of

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[60/] Such information would be stored, regularly updated, and used by the NGSO operator at the gateway level where the user terminals are managed.

[61/] Northpoint NPRM Comments, Technical Annex, at 11.

31.6 dBi at 12.5 GHz.[62] If this limit were to be exceeded, the NGSO FSS user terminal receiver could saturate, resulting in the inability of the user terminal to operate with a carrier inside *or* outside the 12.2-12.7 GHz band.

In order to give MVDDS operators flexibility in designing and deploying their systems, SkyBridge proposes two sets of limits. SkyBridge has avoided proposing a single hard limit, applicable over the entire service area. This could unnecessarily impede MVDDS operators from employing higher power levels in low-population areas (to increase the service area), a technique which may prove feasible in cases where transmitter sites can be found where no user terminals (whether DBS or NGSO FSS) will likely be installed.

As specified in Exhibit A, the first limit would be an EPFD limit of -135.1 dB(W/m^2/4 kHz), which could be exceeded over no more than 0.2% of the service area of the MVDDS system. Compliance with this limit should be verified by computations performed by the MVDDS operator over each service area prior to deployment. This would guarantee that no more than 0.2% of the NGSO FSS user terminals located in an MVDDS service area (uniform distribution of such terminals is assumed for the sake of simplicity) could experience levels of interference close to or in excess of the saturation threshold. This limit and the computations would ensure that MVDDS system designers take into account NGSO FSS systems, and honor their assurances that the areas in which NGSO FSS

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62 See SkyBridge L.L.C. Application, Appendix B to Amendment filed January 8, 1999.

systems will receive interference close to or in excess of the saturation threshold will be small.

The second limit would be an EPFD limit of -132.1 dB(W/m^2/4 kHz), corresponding to the saturation threshold, which would not be exceeded into any operational NGSO FSS user terminal in the service area of any MVDDS system. This limit has been defined on an operational basis only, to give flexibility to the MVDDS operator, and to take into account the fact that simulations could identify saturation zones that would not exist in practice (i.e., areas in which there are no NGSO FSS users or where natural shielding will fade the interference). The operational EPFD will guarantee that if an operational NGSO FSS user actually suffers interference at or above the saturation threshold, the MVDDS operator will have to reduce the interference into that specific user terminal to below the operational EPFD limit. No pre-validation would be carried out to assess compliance with this operational limit. It would be the responsibility of the NGSO FSS operator to make a complaint to the MVDDS operator if interference levels in excess of the limit are measured at a user terminal.

An operational limit is only viable as a regulatory tool in cases where both affected services agree that the likelihood of exceeding the limit is small.[63/] In this case,

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[63/] See, for example, the WRC-2000 rules for protection of GSO FSS systems in bands shared with NGSO FSS systems in Article S22 of the ITU Radio Regulations. In this case, operational-type limits were defined in addition to so-called "validation" limits to protect more sensitive GSO earth stations from synchronization loss. Compliance with these limits is not assessed by the ITU prior to system launch, but can be checked via measurement, as necessary, once both the GSO and NGSO systems are in operation. This regime was

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Northpoint has always claimed that power levels of this magnitude would be quite rare, and SkyBridge, on the basis of such assertions, is willing to accept use of an operational limit in this instance, despite the difficulties, identified above, in performing rigorous analysis on the impact of the Northpoint system on SkyBridge's system.

c. Limit on out-of-band emissions

Finally, it is necessary to ensure that the out-of-band emissions of MVDDS systems into the 11.7-12.2 GHz band are limited, because this band will have to be used by those NGSO FSS user terminals in the Red Zone (when this band is available to them). In other words, the MVDDS out-of-band emissions must be sufficiently low to permit unconstrained operation of carriers that may be available in the lower band.

In the Further Notice, the Commission proposes to require all MVDDS transmitters to meet the emissions mask of Section 101.111(a)(2).[64/] SkyBridge supports application of this mask to MVDDS services, with one important caveat.

The Commission proposes in the Further Notice to expand from 20 MHz to 500 MHz the maximum authorized bandwidth of Fixed Microwave Service carriers in the 12.2-12.7 GHz band, in Section 101.109, in order to accommodate MVDDS systems.[65/]

[63/] (...continued)
accepted by both GSO and NGSO operators in view of the results of studies showing that the likelihood was quite small that, in practice, an NGSO system meeting the validation limits would exceed the operational limits into an operational GSO receiver.

[64/] FNPRM, ¶ 317.

[65/] FNPRM, ¶ 317.

However, by employing this value in the equation for the emissions mask,[66] the Commission's proposal significantly relaxes that emission mask. The Commission's proposed amendment would result in a situation in which there would be no limitation on interference levels as far as 250 MHz below 12.2 GHz (i.e., 11.95 GHz),[67] which could render many carriers in the 11.7-12.2 GHz band unusable to NGSO FSS carriers. The Commission can remedy this situation by expanding the maximum authorized bandwidth to no more than 24 MHz, the bandwidth cited by Northpoint for its system.[68]

In the SkyBridge Proposal, in order to define limits that would not be too constraining to MVDDS systems,[69] SkyBridge proposed out-of-band requirements for MVDDS systems in accordance with the emissions mask applicable the CARS systems in the Ku-band (47 C.F.R. § 78.103), as applied to a wider carrier bandwidth of 24 MHz, and derived an EPFD limit based on that mask. However, SkyBridge believes that the Commission's proposal to apply the tighter emissions mask contained in Section 101.109 will serve the same purpose, so long as the maximum authorized bandwidth is expanded to

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[66] See 47 C.F.R. 101.1111(a)(2).

[67] SkyBridge uses three transponders in the 11.7-12.7 GHz band. This means that the carriers of two out of three SkyBridge transponders could not be used in the frequency diversity plan, thus requiring the third transponder to always be on in all cells in the United States. This poses a large constraint on system design in terms of self-interference and system resource optimization as a function of traffic demand.

[68] See, e.g., First Northpoint Response to MITRE Questions, at 2.

[69] In the Broadwave Applications, Northpoint requested a waiver of Sections 101.109 and 101.111, without specifying what emissions requirements should apply to its service.

no more than 24 MHz. If the Commission adopts that proposal, an EPFD limit on MVDDS out-of-band emissions would not be necessary.[70/]

d. The Commission's cursory objections to the SkyBridge proposal are without foundation.

(i) The Commission's claim that the limits proposed by SkyBridge would not be appropriate for other NGSO FSS systems is unsupported.

In the Further Notice, the Commission rejected the above proposals in part because "the limits proposed would not be appropriate for other NGSO FSS systems that may use the 12.2-12.7 GHz band."[71/] The Commission did not support this conclusion with any evidence that the limits would not permit equitable sharing among all NGSO FSS systems and MVDDS systems in the band. While the limits were developed with a SkyBridge-like system in mind, for the following reasons it would be entirely reasonable and appropriate for the Commission to implement them.

The proposed NGSO FSS systems may be broken down into three classes:

(1) those systems that claim they will not experience interference from Northpoint;[72/]

[70/] If, on the other hand, the Commission decides to relax the mask applicable to MVDDS, as requested by Northpoint, an EPFD limit bounding the out-of-band emissions in the 11.2-11.7 GHz band, as detailed in the SkyBridge Proposal, will be necessary.

[71/] FNPRM, ¶ 280.

[72/] Virtual Geosatellite, LLC ("Virtual Geo") appears to make this claim. See Letter to William E. Kennard from David Castiel and Sophia Collier, ET Docket No. 98-206, March 8, 2000 ("Castiel Letter") at 2. However, the technical basis for this assertion is unclear at best. Despite the higher minimum elevation angle employed by its Virgo system, it would seem unavoidable that Virtual Geo's user terminals located sufficiently near

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(2) those systems, such as SkyBridge, that will receive interference but can implement frequency diversity to mitigate to some extent the adverse effects of such interference, assuming the limitations proposed above are adopted; and

(3) those systems that will receive interference, but which cannot implement frequency diversity because, for example, they employ a frequency re-use pattern that distributes all available frequencies among adjacent cells; they use only one transponder (instead of SkyBridge's three) across the 12.2-12.7 GHz band; or they employ wide carriers, with the result that fewer are available in the lower band.[73/]

For the first class of system, no rules to permit frequency diversity are required, and for the last class, no regulatory scheme that still permitted MVDDS operation would provide adequate protection. In the second category, however, the concerns addressed above apply to all systems. No NGSO FSS system employing small user terminals can afford to employ agile filters at the radio layer input, and therefore all will be susceptible to saturation. Moreover, all will require that MVDDS emissions in the 11.7-

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[72/] (...continued)
MVDDS transmitters will receive harmful interference, particularly in the absence of a strict limit on MVDDS transmit power. Virtual Geo appears to admit as much, stating that its Virgo system and Northpoint should be able to share in most circumstances, "assuming, where that is not possible, that Virtual Geo will avail itself of the frequencies it has requested outside those proposed for Northpoint." Id. More recently, however, Virtual Geo has proposed a band segmentation plan wherein Virgo would employ for its user terminal downlinks only frequencies within in the 12.2-12.7 GHz band proposed to be used by Northpoint. See, e.g., Letter to Magalie Roman Salas from Stephen Baruch, ET Docket No. 98-206, January 22, 2001, at 13. In reality, there are most likely no systems among those currently on file that fall into the "no interference" category.

[73/] As the Commission notes, Northpoint claims that its system is compatible with all proposed systems if modifications are made to some systems and interference avoidance techniques are used. R&O, ¶ 220. However, the changes required to make systems in this third class compatible with MVDDS operations would not be minor. Of equal importance, Northpoint continues to refuse to share any of this burden.